TACOM

Lethality, Survivability, Mobility and Sustainment for America's Army

TRADE-OFFs IN WEAPON SYSTEM DESIGN

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NDIA PRESENTATION
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DISCLAIMER

- **NOT AN OFFICIAL U.S. ARMY POSITION**
- **CONTENT SOLELY OPINION & RESPONSIBILITY OF RON ELBE**

PURPOSE OF PRESENTATION

- **HEIGHTEN AWARENESS OF INTERACTIONS / TRADE OFFs WITHIN WEAPON SYSTEMS**

- **IMPROVE COMMUNICATIONS BETWEEN USER & DEVELOPER**

FIRST PRINCIPLE OF WEAPON SYSTEM DESIGN

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“THERE AIN’T NO FREE RIDES ! ”
(EVERYTHING IS A TRADE-OFF)

TYPICAL SYSTEM TRADE-OFFs

"IMPROVING"	MAY DEGRADE
RELIABILITY	ACCURACY, AFFORDABILITY, PORTABILITY, TERMINAL BALLISTICS
DURABILITY	AFFORDABILITY, PORTABILITY, TERMINAL BALLISTICS
PORTABILITY	AFFORDABILITY, AMMO CAPACITY, DURABILITY, TERMINAL BALLISTICS
FEATURES	AFFORDABILITY, MAINTAINABILITY, PORTABILITY, RELIABILITY
RATE OF FIRE	ACCURACY, CONTROLLABILITY, DURABILITY

TYPICAL SYSTEM TRADE-OFFs (CONTINUED)

"IMPROVING"	MAY DEGRADE
CONTROLLABILITY	PORTABILITY, RATE OF FIRE, TERMINAL BALLISTICS
ACCURACY	AFFORDABILITY (WEAPON & AMMO), DURABILITY, RELIABILITY
INTERCHANGEABILITY	AFFORDABILITY
5% – 95%	FEATURES, TERMINAL BALLISTICS
AMMO CAPACITY	DURABILITY, PORTABILITY

TYPICAL SYSTEM TRADE-OFFs (CONTINUED)

"IMPROVING"	**MAY DEGRADE**
SAFETY	**FEATURES, TERMINAL BALLISTICS**
TERMINAL BALLISTICS	**AFFORABILITY, DURABILITY, PORTABILITY, RANGE, RELIABILITY, SAFETY**
PENETRATION	**LETHALITY, PORTABILITY, RELIABILITY**
MUZZLE FLASH	**PORTABILITY**

TRADE OFFs AFFECT ENTIRE SYSTEM

M856 TRACE DISTANCE & BALLISTIC MATCH

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PROJECTILE SHAPE/LENGTH & TERMINAL BALLISTICS

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RIFLING TWIST, CTG COST, CTG INTEGRITY

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BARREL LIFE, ACCURACY

DESIGNERS JUGGLE TRADE-OFFs TOWARD AN "OPTIMUM DESIGN"

WEAPON SYSTEMS ARE LIKE MOVIES

- **SEQUELS MAY OR MAY NOT BE BETTER THAN THE ORIGINAL**
- **EVOLUTION CAN IMPROVE SYSTEMS, <u>BUT</u>**
  - **ORIGINAL DESIGNER PROBABLY MADE WISE TRADE-OFFs**
  - **DESIGN VARIANTS DEVIATE FROM THOSE TRADE-OFFs**
  - **THE DEVIATIONS AND THEIR RESULTING NEW TRADE-OFFs MUST BE THOROUGHLY UNDERSTOOD BY BOTH DEVELOPER & USER**

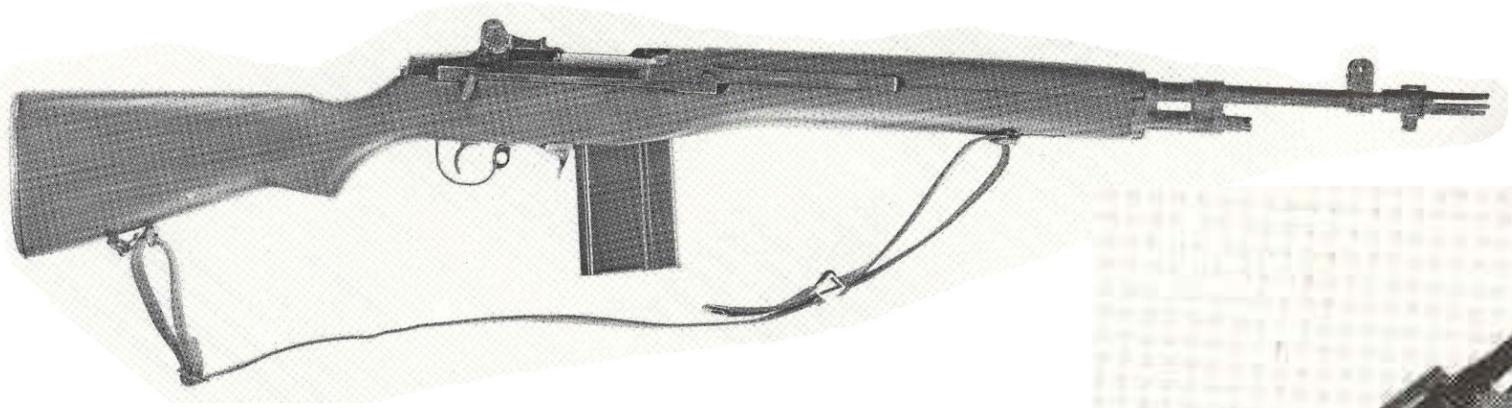
EXAMPLES OF VARIANTS

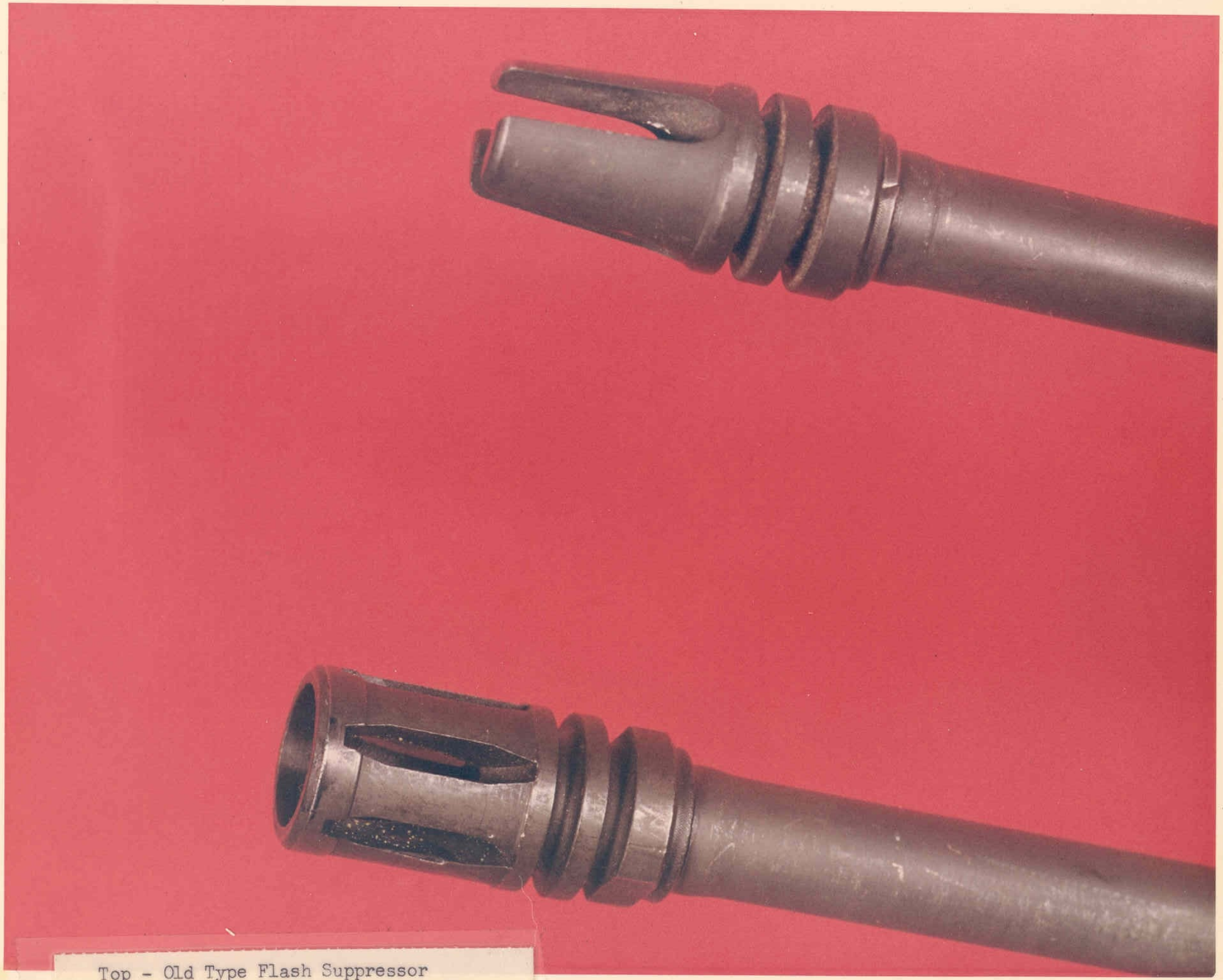
SOME TRADE-OFFs MAY NOT BE OBVIOUS

SO,

HISTORY REPEATS ITSELF

(MUZZLE FLASH VS PORTABILITY)





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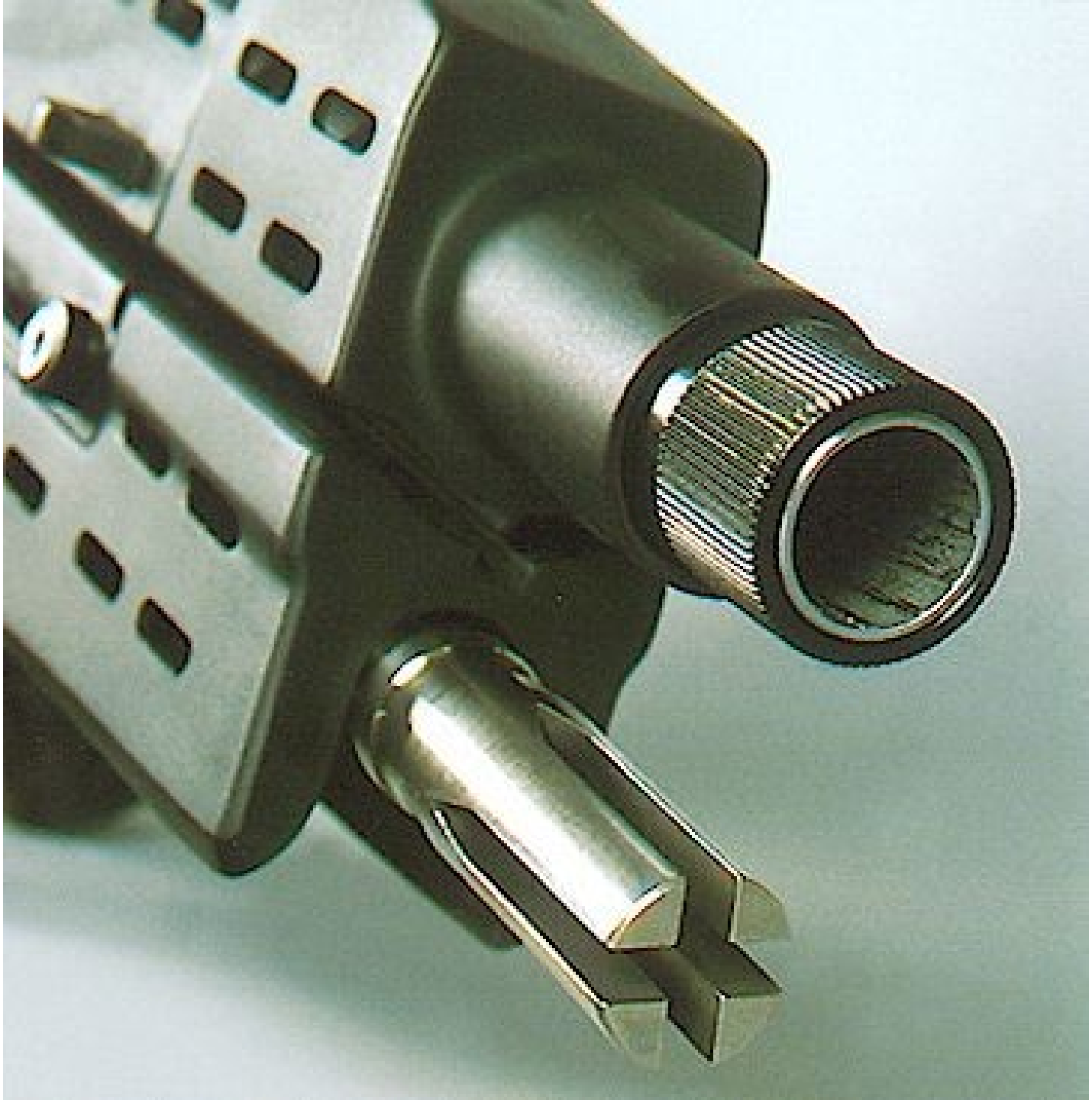

RECOMMENDATIONS TO USERS

- **DON’T MAKE ANY REQUIREMENT MORE STRINGENT THAN NEEDED.**
- **ADDRESS ALL REQUIREMENTS.**
- **BE FLEXIBLE IN YOUR REQUIREMENTS.**
- **ASK ABOUT TRADE-OFFs ! ! !**
- **UNDERSTAND AND ACCEPT TRADE-OFFs.**

RECOMMENDATIONS TO DEVELOPERS

- **TAKE A “TOTAL SYSTEM” VIEWPOINT**
- **UNDERSTAND THE SYSTEM IMPLICATIONS OF**

  EVERY REQUIREMENT
- **MAKE CONSCIOUS TRADE-OFF DECISIONS**
  - **USE A FORMAL TRADE-OFF**

    MATRIX / PROCESS / ANALYSIS
- **EXPLAIN IMPLICATIONS OF USER REQUIREMENTS TO HIM**

BECAUSE • • •

THERE AIN'T NO FREE RIDES ! ! !

(IF YOU DON'T ACCEPT THIS PRINCIPLE, THE SOLDIER WON'T GET OPTIMUM SYSTEM ! ! !)